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ANATOMICAL FEATURES OF THE SPHENOID SINUS

Abdullayev A.,
Head of Department, Associate Professor, Ph.D. in Medicine, Azerbaijan Medical University, Department of Human Anatomy and Medical Terminology. Azerbaijan, Baku.
Garayeva S.,
Assistant, Ph.D. in Medicine, Azerbaijan Medical University, Department of Human Anatomy and Medical Terminology, Azerbaijan, Baku.
Allahverdiyeva N.,
Assistant, Ph.D. in Medicine, Azerbaijan Medical University, Department of Human Anatomy and Medical Terminology, Azerbaijan, Baku.
Nadirli Z.
Ph.D. in Medicine, Azerbaijan Medical University, Department of Human Anatomy and Medical Terminology, Azerbaijan, Baku.
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Abstract

The sphenoid sinus is in a particularly close topographic relationship with the pituitary gland, cavernous sinus, optic nerve, and other cranial nerves. The article discusses the current state of the study of the morphological features of the sphenoid sinus, the degree of pneumatization, and the relationship with closely spaced anatomical structures. The sphenoid sinus is formed as a result of pneumatization of the sphenoid bone, located in the center of the base of the skull. Being a self-developing cavity, it is formed in a 3-month-old fetus as a result of a weak protrusion of the epithelium and mesenchyme of the nasal cavity. The anatomical formations surrounding this sinus include parts of the brain, nerves, and blood vessels. Therefore, in cases of purulent-inflammatory processes in the sinus, as well as during surgical interventions performed through the sphenoid sinus (transsphenoidal transition), it is necessary to have a complete picture of its clinical and anatomical variants. A close acquaintance with the literature proves once again that the development of pathologies of the respiratory system, especially viral etiologies, every year, the possibility of their transition to epidemics and pandemics with a fatal outcome, encourage morphologists to more in-depth study structural options, their frequency of occurrence, and relationships with neighboring anatomical formations of the nasal cavity and its additional air cavities, which are considered the natural gates of this system.

Keywords: sphenoid sinus, degree of pneumatization, pterygoid canal, anterior clinoid process.

In recent years, a sufficient number of facts have been collected proving the important role of the pathology of the sphenoid sinus in causing damage to adjacent organs. The sphenoid sinus is in a particularly close topographic relationship with the pituitary gland, cavernous sinus, optic nerve, and other cranial nerves [1, p. 2613-2618; 2, p. 669-74; 3, p.951-5]. Given the above, it is important to study the anatomical variants of the sphenoid sinus [4, p. 195-201; 5, p. 627-632]. The authors consider endoscopic endonasal interventions in the area of the sella turcica with passage through the sphenoid sinus as an alternative to the classical microsurgical operations used so far and discuss their prospects. In general, the sphenoid sinus, like other paranasal sinuses, tends to have wide anatomical variability, and therefore all its variants must be investigated in great detail.

The sphenoid sinus is formed as a result of pneumatization of the sphenoid bone, located in the center of the base of the skull. Being a self-developing cavity, it is formed in a 3-month-old fetus as a result of a weak protrusion of the epithelium and mesenchyme of the nasal cavity. As rightly indicated in the literature, the age-related morphology of the sphenoid sinus has not been fully studied. This is especially true for the first years of the postnatal period. A variety of data has been obtained for this age period.

[6, 364 p.] noted that in newborns, the rudiment of the sphenoid sinus is a part of the mucous membrane of the nasal cavity that develops posteriorly and is 1.6-4 mm long, 1-4 mm high, and 2 mm wide. Naturally, the topography of the sphenoid sinus is of great importance. The anatomical formations surrounding this sinus include parts of the brain, nerves, and blood vessels. Therefore, in cases of purulent-inflammatory processes in the sinus, as well as during surgical interventions performed through the sphenoid sinus (transsphenoidal transition), it is necessary to have a complete picture of its clinical and anatomical variants. It is important to take into account the contact of the neurovascular structures mentioned above with the walls of the sinus. The anterior wall of the sphenoid sinus is very important from a practical point of view. It has a very important role in the passage of inflammatory processes from the nasal cavity to the sphenoid sinus. It is customary to divide the area of the anterior wall topographically into two parts. These are the nasal and ethmoid parts. The ethmoid part is located laterally, and the nasal part is medially. The ethmoid part is occupied by ethmoid cells in contact with the anterior side of the sphenoid sinus. The nasal part opens into the nasal cavity; if the middle nasal meatus is wide enough, then this part is visible with anterior rhinoscopy. The parametric possibilities of interventions performed on the sphenoid sinuses largely depend on the width of this part. On skulls, the ratio of the ethmoid part of the anterior wall of the sphenoid sinus to its nasal part was studied [7, p. 29-39]. This ratio was determined by the author to be 5:2. At the same time, only 4 mm belongs to the nasal part. In a living person, during rhinoscopy, this bone strip is even narrower. Even if pathological changes are not observed (for example, deviation of the nasal septum or hypertrophy of the middle turbinate), in this case, the nasal part of the anterior wall is occupied by the mucous membrane covering these formations.

It should be borne in mind that the cells of the ethmoid labyrinth penetrate into the body of the sphenoid bone and displace its sinus posteriorly. Along with this, the sphenoid sinus can also descend downward. In such cases, the border between the posterior cells of the ethmoid labyrinth and the sphenoid sinus is very difficult to determine. The upper edge of the anterior wall of the sphenoid sinus borders on the cribriform plate and the upper posterior cells of the cribriform labyrinth. The optic nerve passes through the superior lateral angle of the anterior wall. It is known that the superior orbital fissure is located in the lower part along with the ophthalmic vein and nerves passing through it (the III, IV, and VI cranial nerves and the 1st branch of the V cranial nerve).

The lateral-lower angle of the anterior wall of the sphenoid sinus is connected to the sphenoid and orbital processes of the palatine bone; a spheno-palatine notch is formed between these processes. The lower edge of the anterior wall forms an angle with the lower wall of the body of the sphenoid bone. During surgical interventions in this area, it is this angle that is taken as the border between the nasal cavity and the nasal part of the pharynx. The superior wall of the sphenoid sinus, its topography, and its shape are also of great importance. According to the most recent literature, endonasal pituitary surgery has increased interest in the superior wall of the sphenoid sinus; clarification of morphological knowledge concerning this wall is directly in the interests of the clinic. The pituitary gland can be accessed through the sphenoid sinus. In principle, this applies to all types of surgical interventions [8, p. 291-307]. That is why the topographic relationship between the sphenoid sinus and the sella turcica is of great importance. The diameter of the sella turcica, or in other words, the distance between the tubercle and dorsum of the saddle, fluctuates in a very small range, which is 10–12 mm. The flexure of the sella turcica often approaches a semicircle [9, p. 291-7]. The authors argue that the direction of the diameter depends more on the position of the tubercle of the saddle, or its flexure. We can assume that the nature of the pathology and its intensity are the leading factors in the development of the pathological process. The thickness of the walls of the sinus is a factor only in cases where the walls are subjected to direct pressure. These may include, first of all, injuries and the results of surgical interventions. With thin walls of the sphenoid sinus, injuries have a more severe outcome; also, a surgeon working in similar conditions (with thin walls of the sphenoid sinus) requires special care. When diagnosing pathological processes of the paranasal sinuses, in particular, the sphenoid sinus, the X-ray method is quite widely used. Along with the correct diagnosis, this method allows you to acquire important information about the anatomical structure of the sinuses. As we noted, the anterior wall of the sphenoid sinuses is very important from a practical point of view. The study of x-ray images of the skull revealed three forms of the anterior wall [10, p. 43-47]. The first group includes sinuses with an obliquely placed anterior wall. It should be noted that statistically, the sinuses belonging to this group make up the majority. So, they occur in 73.4% of all cases. The anterior wall of the sinuses in the second group is rounded and convex anteriorly (23.3%). Sphenoid sinuses with vertically located anterior walls on x-rays are a minority (3.3%).

A correct understanding of the degree of pneumatization of the sphenoid sinuses can help determine their volume. From this point of view, small, medium, and large sinuses are identified by the type of pneumatization. Small sinuses have a volume of 0.5–10 cm^3, while medium sinuses have a volume of 11–20 cm^3. Large sinuses include sphenoid sinuses with a volume greater than 20 cm^3 [10, p. 43-47]. According to the author, small sinuses occur in 21% of cases, medium in 44%, and large in 35% of cases. With dolichocranial and brachycranial forms of the skull, there is a direct relationship between the length of the face and the volume of the sphenoid sinus. In the mesocranial form, this dependence is absent. With all three forms of the skull, there is a direct relationship or correlation between the width of the face and the volume of the sphenoid sinus; an increase in the width of the face is accompanied by an increase in the volume of the sphenoid sinus and vice versa. The volume of the sphenoid sinus compared to other forms of the skull is greater in dolichocranial skulls. In other words, the large sinuses that we described above are most often found in them. The smallest sinuses are found in brachycranial skulls [11, p. 33-34]. The possibility of development of the sphenoid sinuses in the direction of the surrounding anatomical structures depends on the shape of the skull. Among all the deviations from the normal pneumatization of the sphenoid sinus, its spread towards the basilar part of the occipital bone is the most common. In this case, the sinus reaches its largest size [7, p. 29-39]. This is more common in brachycranial, somewhat less common in mesocranial, and, finally, rare in dolichocranial skulls. When spreading toward other anatomical elements, the shape of the skull does not play a special role. So, with all forms of the skull (dolichocranial, mesocranial, and brachycranic), the sphenoid sinus, with the same frequency, can develop toward the pterygoid process of the sphenoid bone to varying degrees. Another important clinical point is that the sphenoid sinus can develop toward the optic canal on its own or on the opposite side as the degree of pneumatization increases; at the same time, the skull's belonging to the dolicho-, meso-, and brachycranial regions has no bearing. The sphenoid sinus, as a result of its development, can also reach the foramen rotundum and foramen ovale.

Quite interesting data have been obtained regarding the anatomical variants of the sphenoid sinus using the method of computed tomography. The authors noted that in 267 people (534 sphenoid sinuses), the pterygoid process and the anterior clinoid process were pneumatized, respectively, in 39.7% and 17.2% of all cases. The pterygoid canal protrudes into the cavity of the 158 sphenoid sinuses, of which 60 are bilateral [12, p. 109-14]. The study emphasizes that there is a relationship (correlation) between the protrusion of the pterygoid canal into the sphenoid sinus and the pneumatization of the pterygoid process. An association has also been reported between protrusion of the optic canal into the sphenoid sinus and pneumatization of the anterior clinoid process.

Thus, the dynamic increase in the number of diseases of the nasal cavity and paranasal sinuses requires and causes the intensification of research work devoted to the study of these cavities. A close acquaintance with the literature proves once again that the development of pathologies of the respiratory system, especially viral etiologies, every year, the possibility of their transition to epidemics and pandemics with a fatal outcome, encourage morphologists to more in-depth study structural options, their frequency of occurrence, and relationships with neighboring anatomical formations of the nasal cavity and its additional air cavities, which are considered the natural gates of this system. Of course, the normal functioning of the nasal cavity and paranasal sinuses largely depends on the characteristics of their air supply and disorders in this supply process.

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